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Southwestern
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Botany Specialist Report

Kaibab Forest Plan Revision FEIS

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Note: Previous versions of this report were written by Barbara C. Phillips; Zone Botanist (now retired) for the Coconino, Kaibab, and Prescott National Forests.

Introduction

This report evaluates and discloses the potential environmental consequences on the Botanical resources that may result with the adoption of a revised land management plan. It examines, in detail, four different alternatives for revising the 1988 Kaibab National Forest land management plan.

This Specialist's Report documents the effects on threatened, endangered, proposed, sensitive (TEPS) plant species and Forest Plan Revision analysis plant species and assesses the effects of the Alternatives being developed. This report provides brief summaries of the ecology and distribution of the TEPS and analysis plant species and addresses the concerns and mitigation for potential treatment effects on the plants. The findings of impacts for the selected alternative will be addressed in the Biological Assessment.

Relevant Laws, Regulations, and Policy that Apply

National Forest Management Act (NFMA) regulations, adopted in 1982, require that habitat be managed to support viable populations of native and desirable non-native vertebrates within the planning area (36 CFR 219.9). USDA regulation 9500-004, adopted in 1983, reinforces the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired non-native plants, fish, and wildlife. For planning purposes, a viable population shall be regarded as one that has the estimated numbers and distribution of reproductive individuals to ensure its continued existence is well distributed in the planning area (36 CFR 219.19). Also, the 1982 planning provisions require that "Forest planning shall provide for diversity of plant and animal communities and tree species consistent with the over-all multiple-use objectives of the planning area" (36 CFR 219.26).

Shown below is a partial list of federal and state laws, executive orders, and Forest direction pertaining to project-specific planning and environmental analysis for this Plan.

- Executive Order (EO) 11644 and EO 11989
- Kaibab National Forest Land and Resource Management Plan, 1988 (as amended)
- Endangered Species Act, 1973 (as amended)
- Forest and Rangeland Renewable Resources Planning Act (RPA), 1974 (as amended)
- Forest Service Manual, FSM 2620, 2630, 2670, 2672
- Multiple-Use Sustained-Yield Act of 1960
- National Environmental Policy Act, 1969
- National Forest Management Act, 1976 (as amended); 36 CFR 219.

Methodology and Analysis Process

The management situation on the Kaibab National Forest (NF) was analyzed in the 2009 Comprehensive Evaluation Report (CER) (KNF 2009) and Supplement to the CER (2010) (KNF 2010). The CER evaluated the need for change in light of how management under the current Plan (as amended) was affecting the conditions and trends related to sustainability. The CER integrated key findings from the Ecological and the Socio-Economic Sustainability Reports (KNF 2008a; KNF 2008b). The CER

considered information from these two reports and used them to identify where the conditions and trends indicated a need for change the Plan. The Supplement to the CER contains additional analysis and information about projections of demand, benchmarks, and species considerations. Together, these documents meet the content requirements of the Analysis of the Management Situation (AMS). These documents are available for review and are located on the forest's Web site at: http://fs.usda.gov/goto/kaibab/plan_revision.

The CER/AMS and subsequent Management Reviews identified four areas where there were priority needs for change in program direction.

- Modify stand structure and density towards reference conditions and restore historic fire regimes.
- Regenerate aspen to insure long-term healthy aspen populations.
- Restore natural waters and wetlands to insure healthy riparian communities.
- Restore historic grasslands by reducing tree encroachment and restoring fire.

A species diversity analysis process was used to consider the relationships between ecosystem diversity components and select plant taxa in the plan area by using explicit criteria following national direction to identify species considered to be of concern or interest in the plan area. This analysis process is described in more detail in the Kaibab NF Species Diversity Report (SDR) (KNF 2008c).

The list consisted of Threatened and Endangered (T & E) species for Region 3; Species-of-Concern (SOC) and potential Species-of-Interest (SOI) that occur within the forest plan area. The FWS maintains lists for Threatened and Endangered (T & E) species federally listed under the Endangered Species Act (1973) at www.fws.gov/endangered/. T & E species were included if known or likely to occur on the forest. NatureServe (www.natureserve.org) maintains ranking information that informed identification of SOC and SOI (NatureServe 2008). Later, SOC and SOI were combined under the name Analysis Species.

An iterative approach was used to develop a species diversity database (including plants, macro-lichens, invertebrates, reptiles, amphibians, birds, and mammals) with population or habitat concerns in Arizona using criteria and guidelines: (FSH 1909.12.40.43.22b); (FSH 1909.12.40.43.22c) (KNF 2008c).

Since many of the potential SOI species were not at significant local risk, or of high public interest, it was necessary to use additional criteria to determine those that merited approval as SOI. These were:

- Species habitat or population has declined significantly in the plan area.
- Species and its habitats are not well-distributed in the plan area.
- Species population numbers are low in the plan area.
- Species is dependent on a specialized habitat or one that is limited in the plan area.
- There is some imminent threat to the species.
- Species habitat or population is not generally secure in the planning area, and NFS lands act as an important refuge.

Sources of information for Forest planning plant species included, but were not limited to:

- The Southwestern Regional Forester Sensitive Species List
- Feedback from a local Species Diversity Workgroup
- Arizona State Heritage Data Management System

- Arizona Rare Plant Task Force
- Taxonomy books, field guides, journals, various publications
- On-line herbaria (accessed through SEINet <http://swbiodiversity.org/seinet/index.php>)
- Species listed or ranked within various strategies, agreements and lists such as under Arizona's administrative rules and laws (Highly Safeguarded Protected Native Plants of Arizona)
- Local, regional or national experts for various plant species and taxa
- Various TECS plant survey documents and data on file at Kaibab and Coconino National Forests (paper copies)
- TECS plant data filed in
fsfiles/ref/library/gis/projects/forest_wide/wildlife/sens_plants/plant_point
fsfiles/ref/library/gis/projects/forest_wide/wildlife/sens_plant/plant_poly
fsfiles/ref/library/gis/projects/forest_wide/wildlife/sens_plants/plant_line
- NRIS-TESP/INPA database.

T: FS-NITCNRMSEDServers\Production\S_R03-KAI

Additional input resulting from:

Continued Monitoring of rare plants since 2008 – especially Cimi and Pepa

Work on Pepa Conservation Assessment and Strategy, including Team meetings with FWS

Forest and District project assessments including Travel Management Rule (TMR) and fires (Warm Fire and others)

Screening Results

If the resulting SOC and SOI in the database met any of the following criteria they were not subjected to further detailed analysis in the planning process (FSH 1909.12, CH 40, Sec. 43.22d):

- Species does not occur on the forest and there is no known habitat in the plan area.
- Species is secure in the plan area based on occurrence, distribution, available habitat, and response to natural disturbance and/or management.
- There is too little information to complete a reliable assessment (taxonomic uncertainty, habitat needs, population trend estimates).
- Species are not affected by any form of current or potential management or lack of management in the plan area.

Species Diversity Database

The Species Diversity Database for the Coconino, Kaibab and Prescott NFs currently contains information on >1,800 plant and animal species (Appendix B, KNF 2008c), and the screening results and rationale for each. The screening process resulted in 82 plant species carried forward in the Kaibab NF species diversity analysis process (Table 1, KNF 2008c). Those species not carried forward were retained in the species diversity database and the project record should future information become available that might warrant reconsideration at a later date. The majority of species (>1,400) were screened out because they did not occur in the planning unit, or there was insufficient information to complete a reliable assessment. Without adequate information on species habitat needs and/or population and status trends it is difficult, if not impossible, to devise adequate management policies. For many of these species additional research is necessary and encouraged. At least 50 species were screened out because of taxonomic uncertainty. The remaining species (>220) were screened out because they were secure in the planning unit or were unlikely to be affected by current management or lack of management.

Species Diversity Process

Two types of basic information were initially used to group forest planning species carried forward in the species diversity analysis process: terrestrial or aquatic habitat associations, and biotic or abiotic habitat components. Species were grouped first by habitat association, represented by water or the broadly defined vegetation types historically present in the planning area (i.e. PNVT, Potential Natural Vegetation Type; see Table 3, KNF 2008c). Potential Natural Vegetation Types represent the land's potential vegetation under natural disturbance or biological regimes, minus human induced change (KNF 2013a, KNF Vegetation Fire and Fuels Report). Species were secondarily grouped by habitat components not specifically addressed by broad habitat associations.

Information gathered on each species was reviewed and a determination made as to whether the threats to the terrestrial and aquatic ecosystem diversity characteristics were also affecting the species. In general, it was assumed that those species associated with PNVTs or water sources departed from and trending away from historic conditions were at risk. Many species were associated with more than one PNVT. Habitat-specific threats related to ecosystem diversity characteristics included effects such as fire, vegetation type conversion, overgrazing, insect outbreaks and exotic species invasion. These threats and their impacts on PNVTs are treated more intensively in the Kaibab National Forest vegetation, fire and fuels report (KNF 2013a). Threats associated with water can be found in the soils and watershed report (KNF 2013b).

If species had other threats to their habitat which could not be accounted for by ecosystem diversity risks alone, those threats were categorized separately by related habitat features (Table 4, KNF 2008c). This included species which might depend on non-vegetative features or fine-scale microhabitat components found within the broader context of their habitat. Finally, some species face threats that are not related to ecosystem diversity characteristics or habitat features, and they are identified in Table 5 (KNF 2008c). Some species that occur on the Forest face an additional threat simply by virtue of their relatively limited range-wide distribution. These species might be easily affected by localized and/or stochastic events, and were noted separately regardless of whether or not they were associated with habitat level threats. A taxon was considered to have a Restricted Distribution if it occurs to a limited extent in the Southwest; a species was also considered to be a Narrow Endemic if it has extremely limited distribution and/or habitat in northern Arizona. Due to their limited distribution and potential susceptibility to perturbation, these species may require additional management considerations. There were 62 plant taxa for which their restricted distribution was considered an additional threat. Of these, 38 were listed as narrow endemic plant taxa (Table 6, KNF 2008c).

Species Viability

This plant species viability evaluation focuses on information relevant to the Kaibab National Forest. Our goal for this evaluation is to use a clearly defined, transparent process to identify species for which there are substantive risks to maintenance of viable populations, and to ensure consideration of appropriate habitat management strategies to reduce those risks to acceptable levels where feasible.

Because NFMA regulations require providing habitat for species viability within the planning area, focus of this evaluation is on habitat provided on national forest land. Surrounding private lands may contribute to, or hinder, maintenance of species viability on national forest land, but are not relied upon to meet regulation requirements. For this reason, habitat abundance was assessed based on conditions found on national forest land. Habitat distribution, however, was assessed considering the condition of intermixed ownerships and conditions, which may affect the interactions of species among suitable habitat patches on national forest lands.

Using the results from the Species Diversity Analysis process (KNF 2008c), a comprehensive list of species with potential viability concerns was compiled for the Kaibab National Forest. Further information was collected regarding many plant species retained for Forest Plan Revision since the Species Diversity Analysis process was conducted. Additional documentation on locations, habitats, and potential threats has been gathered from many sources. New information was obtained from the SEINet electronic herbarium database and talking with species experts. The Species Diversity Database has been updated to reflect this new information.

Forest Service botanists developed Forest Ranks, or F Ranks, following, in general, the conventions used by NatureServe and others in defining State and Global Ranks (Table 1). The F Ranks were used in viability risk assessment as a categorical variable representing a species' current abundance.

Table 1. Forest (F) ranking for Forest Planning Species

F ranking	Description
F?	Present on the forest, but abundance information is insufficient to develop risk
F1	Extremely rare on the national forest
F2	Very rare on the national forest
F3	Rare and uncommon on the forest
F4	Widespread abundant and apparently secure on the forest
F5	Demonstrably secure on the forest
FP	Possibly could occur on the forest, but documented occurrences not known
FO	Does not occur on the forest

Only those species that are both confirmed present and rare or of unknown abundance (F1 through F3, and F?) on the Kaibab National Forest were assessed for viability risk. Species ranked as F? were treated as F1 species to provide a conservative approach to those species for which abundance information is not available. Species that are currently abundant on the forest (F4, F5) are assumed to be at low risk of losing viability within the next 50 years, and therefore, were not further evaluated for viability risk.

Table 2. Habitat elements used to plan for, and assess risk to, viability of plant species during forest plan revision, Kaibab National Forest.

Habitat Element	Element Description
Pinyon-Juniper Woodland.	A shifting mosaic of continuous canopy is interspersed with openings across the landscape. Tree basal area is variable, but has at least 10% canopy cover.
Ponderosa Pine Forest	Mid- and late-successional ponderosa pine forests with frequent low intensity fire in the system (FRI, 0-35 years)
Spruce Fir Forest	Mid- and late-successional spruce fir stands having more closed conditions due to infrequent disturbances
Aspen-within Mesic Mixed Conifer forests	Aspen occurs as a shifting mosaic across its range with new aspen clones establishing over time.
Sagebrush Shrubland	Dominated by mature grasses and sagebrush. The majority of sagebrush is in mid-seral or mature states.
Montane/subalpine meadows and grasslands	Small to large mature openings within forested stands; circular, or long linear dimensions
Colorado Plateau/Great Basin Grassland	Grasses and forbs with minimal tree canopy. Vegetation height and canopy cover are sufficient to support fire on a 10 to 30 year return interval.
Semi-Desert Grassland	Grasses with shrub density <10 percent, FRI 10-30.
Desert Communities	Desert grasses, desert shrubs, succulent species and some herbaceous cover
Rocky outcrops, cliffs, and canyons.	Rock outcrops and cliffs characterized by exposed rock, shallow soils and sparse vegetation
Talus/rocky slopes	Talus and rocky slopes in subalpine areas
Wetland/Cienega, Seeps/Springs (Natural Waters)	Perennial and/or ephemeral springs or headwater streams with pools of standing water. For wetlands, hydrophytic plants are present.
Cottonwood-willow Riparian Forest	Structurally diverse forest characterized by mid-age to mature cottonwood and willow trees with interspersed areas of young trees, grass and shrubs and permanent water (streamside vegetation).

Effects to the habitat elements in Table 2 are analyzed in specialist reports for other sections. Based on these analyses, each habitat element was assigned categorical values by alternative to indicate future abundance (Table 3) and distribution (Table 4), general likelihood that the habitat element would limit viability of associated species (Table 6), and overall effect of national forest management on the habitat element (Table 7).

The future abundance variable (Table 3) is defined as the abundance of the associated habitat element in 50 years if the alternative was selected and implemented over that 50-year period. Definitions of abundance categories are stated in quantifiable terms in order to be as objective as possible; however, in many cases quantifiable estimates of future abundance are not available. In these cases, knowledge of Forest Service specialists was used to assign abundance values based on current conditions and the magnitude and direction of effects expected under each alternative. Rare plant species are distributed by more restrictive habitat features such as soil types within habitat elements so the more general habitat elements such as P-J Woodland were used when the likelihood of limitations were the same.

Table 3. Values used to categorize projected abundance of each habitat element after 50 years of implementing each forest plan revision alternative.

Habitat Abundance Value	Description
Rare	The habitat element is rare, with generally less than 100 occurrences, or patches of the element generally covering less than 1 percent of the national forest planning area
Occasional	The habitat element is encountered occasionally, and generally is found in 1 to 10 percent of the national forest planning area.
Common	The habitat element is abundant and frequently encountered, and generally is found on more than 10 percent of the national forest planning area.

Similar to the future abundance variable, the future distribution variable (Table 4) is defined as the distribution of the associated habitat element in 50 years if the alternative were selected and implemented over that 50-year period. In contrast to the abundance variable, it includes consideration of intermixed ownership patterns and conditions, and their general effects on movements and interactions of individuals among the suitable habitat patches found on national forest lands. This approach relies on the assumption that a habitat distribution similar to that which supported associated species during recent evolutionary history will likely contribute to their maintenance in the future, and that the further a habitat departs from that historical distribution, the greater the risk to viability of associated species. This approach has its own set of difficulties, as evidence of pre-settlement conditions relevant to the planning area is often anecdotal and scarce. Nevertheless, the precision required to assign the categorical values for this variable is not high, and may be supported by general positions described in mainstream conservation literature. Knowledge of Forest Service specialists was used to assign distribution values, based on interpretations of historical conditions supported by conservation literature, current conditions, and magnitude and direction of effects expected under each alternative.

Table 4. Values used to categorize projected distribution of each habitat element after 50 years of implementing each forest plan revision alternative.

Habitat Distribution Value	Description
Poor	The habitat element is poorly distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches and /or their evenness in distribution across the landscape is greatly reduced.

Fair	The habitat element is fairly well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches and/or their evenness in distribution across the landscape is somewhat reduced.
Good	The habitat element is well distributed within the planning area and intermixed lands relative to conditions present prior to European settlement. Number and size of habitat patches and /or their evenness in distribution across the landscape is similar to or only slightly reduced relative to reference conditions.

Habitat element abundance and distribution variables were combined to create one variable to indicate the general likelihood that the habitat element would be limiting to populations of associated species (Table 6). In this general context, habitat limitation refers to a habitat factor, quantity, distribution, or quality, that results in risk to continued existence of the species within the planning area. Table 5 defines the definitions used for habitat limitations.

Table 5. Definitions for habitat limitations to species viability

Habitat Limitation	Description
High	High probability that habitat will be a limiting factor for species viability
Moderate	Habitat has a likelihood of having some limiting factor for species viability
Low	Habitat will likely not be a factor in limiting species viability

Everything else being equal, quality habitat elements that are rare and poorly distributed are those most likely to cause risk to viability of associated species; those that are common and well distributed are least likely to cause risk to viability of associated species.

Table 6. Likelihood of habitat limitation to associated species as derived from habitat abundance and distribution values.

Habitat abundance	Habitat Distribution		
	Poor	Fair	Good
Rare	High	High	Moderate
Occasional	High	Moderate	Low
Common	Moderate	Low	Low

Providing for species viability requires providing abundant and well-distributed habitat in ways that allow existing populations to persist or expand. The ability of existing populations to respond to available habitat depends in part on their current robustness, which is generally a function of population size. In

general, for a given habitat condition, small populations will be at more risk than large populations. To reflect this fact, the likelihood of habitat limitation variable was combined with a species' F Rank (Table 1) for each species/habitat element interaction to generate viability risk rating (Table 7).

Associations of very rare species with habitat elements that are likely to be most limiting were identified as those most at risk; associations of more common species with habitats less likely to be limiting received lower risk ratings. Ratings include three levels of "high" risk (Very High, High, Moderate-High in Table 7) to ensure results err on the side of caution.

Table 7. Viability risk rating for species/habitat interactions as a function of species' F Rank and likelihood of habitat element limitation variables.

Likelihood of Habitat Element Limitations	Species F Rank		
	F? or F1	F2	F3
High	Very High	High	Moderate-High
Moderate	High	Moderate - High	Moderate
Low	Moderate-High	Moderate	Low

Once a viability risk rating was developed for each species/habitat relationship, habitat elements most commonly associated with risks to species viability were identified by counting the number of very high, high, and moderately high ratings associated with each. To assess the role of national forest management in minimizing viability risk associated with each habitat element, a management effects variable was assigned to each habitat element by alternative. The management effects variable (Table 8) categorized the goal of management for the habitat element, the expected resulting trend, and any additional opportunity for minimizing viability risk. Numbers of very high, high and moderately-high risk ratings were summarized by management effects variable by alternative to assess how well alternatives address viability-related habitat needs.

Table 8. Values used to categorize the effect of nation forest management in minimizing or contributing to species viability risk associated with each habitat element by forest plan revision alternative.

Management Effect Value	Description
1	Abundance and distribution of the habitat element is maintained or improved by providing optimal protection, maintenance, and restoration to all occurrences (with limited exceptions in some cases). Little additional opportunity exists to decrease risk to viability of associated species because management is at or near optimal.
2	Abundance and distribution of the habitat element is improved through purposeful restoration, either through active management or passively by providing for successional progression. Opportunity for decreasing risk to associated species is primarily through increasing rates of restoration, where possible
3	The habitat element is maintained at approximately current distribution and

abundance, though location of elements may shift over time as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing objectives to increase abundance and distribution of the habitat element.

- 4 Regardless of management efforts, the habitat element is expected to decrease in distribution and abundance as a result of factors substantially outside of Forest Service control (e.g., invasive species, climate change). Opportunity to reduce risk to viability of associated species is primarily through cooperative ventures with other agencies and organizations.
 - 5 The habitat element is expected to decrease in distribution and abundance as a result of management action or inaction. Opportunity to reduce risk to viability of associated species is primarily through adopting and implementing objectives to maintain or increase this habitat element.
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Distribution of viability risk was also summarized by species status, i.e. federally listed under the Endangered Species Act, listed as Regional Forester's sensitive species, or identified as locally rare or of other concern. The species status summary highlights the relative role of other provisions included in law and policy that result in additional consideration of at-risk species during planning.

Assumptions

In the analysis for this resource, the following assumptions have been made:

- The land management plan provides a programmatic framework for future site-specific actions.
- Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions).
- Land management plans may have implications, or environmental consequences, of managing the forests under a programmatic framework.
- The plan decisions (desired conditions, objectives, standards, guidelines, management areas, monitoring) will be followed when planning or implementing site-specific projects and activities.
- Law, policy, and regulations will be followed when planning or implementing site-specific projects and activities.
- Monitoring identified in the Monitoring Chapter will occur and the land management plan will be amended, as needed.
- The Forest will be funded similar to past budget levels (past 5 years).
- The planning timeframe is 15 years; other timeframes may be analyzed depending on the resource (usually a discussion of anticipated trends into the future).
- The kinds of resource-management activities allowed under the prescriptions are reasonably foreseeable future actions to achieve the goals and objectives. However, the specific location, design, and extent of such activities are generally not known at the time. The decisions are made on a site-specific (project-by-project) basis. Therefore, the discussions should refer to the potential for the effect to occur and are usually only estimates. The effects analyses are to be useful for comparing and evaluating alternatives on a forest-wide basis. It is not intended to be applied directly to specific locations on the Forest.

- The quality of the habitat elements in 50 years is based on how long it will likely take to meet the desired conditions for the different vegetation types
- A habitat distribution similar to that which supported associated species during reference conditions will likely contribute to their maintenance in the future, and the further a habitat departs from that historical distribution, the greater the risk to viability of associated species.

Description of Affected Environment (Existing Condition) – Botanical Resources

All PNVTs analyzed in the terrestrial vegetation report in the Ecological Sustainability Report (KNF 2008a) were departed from reference conditions, suggesting that the associated species' habitat needs were not being met and therefore not sustainable given current management practices. Plant habitat elements associated with fine-scale habitat features not captured by coarse PNVt descriptions include: rocky outcrops, cliffs and canyon; and basalts and other soil types. Current conditions of the habitat elements that provide the affected environment particularly related to the Forest Plan Analysis plant species are described below.

In the Pinyon-Juniper Woodlands and Ponderosa Pine Forest severe wildfire effects represent a significant threat, particularly when combined with secondary threats of uncharacteristic insect/drought-related die-off and invasive plants (KNF 2009). There are 29 Forest Planning plant species that reside in Pinyon-juniper woodlands, important species currently being affected by these changes and threats to the PNVt are Paradine plains cactus, Disturbed rabbitbrush, Cliff milkvetch, Kaibab beardtongue, and Western flameflower. There are 25 Forest Planning plant species associated with the Ponderosa Pine Forest, notable ones include: Rusby milkvetch, Hairy clematis, Kaibab beardtongue, and Western flameflower.

The Mixed Conifer Forests are highly departed from reference condition. Dieback and decline of aspen across northern Arizona began in June of 1999 when over 100,000 acres of aspen were affected by a severe frost event (Fairweather et al. 2008). Tree mortality was even heavier from the 2002-2003 drought period. Secondary agents included cytospora canker, bronze poplar borer, other canker fungi and insects. Once trees started to decline they did not improve with the weather but kept declining until they died. Arizona bugbane, Colorado blue columbine, Rusby milkvetch, and Mountain Whitlow-grass occur in the Mesic Mixed Conifer with Aspen vegetation type.

Current tree density and canopy cover are substantially greater than during the reference period in the Spruce-fir PNVt (KNF 2008a). However, on Bill Williams Mountain within the Arizona Bugbane Botanical Area, large old Douglas fir trees are dying (Phillips and Johnson 2002, personal observation). Douglas fir beetles are the main culprit for Douglas fir deaths. They initially attack those trees most severely infected by dwarf mistletoe first and then move into the uninfected/lightly infected trees. There is typically an association with root disease (*Armillaria*) infection and Doug fir beetle attacks as well (Fairweather 2006).

The primary threats to the Sagebrush Shrublands are lack of characteristic fire disturbance, limited nutrient cycling, and closed-canopy shrub states resulting from juniper encroachment. These interrelated threats create large areas susceptible to stand-replacing fire events. Further departure from reference conditions are predicted under the current management and disturbances. Bison herbivory may pose a secondary threat on the NKRd. Fires occurring under current conditions may lead to negative outcomes for native species composition. Increased invasive plant cover after wildfire is considered a moderate risk (Kaibab National Forest 2009). Paradine plains cactus is a very rare plant that occurs in this vegetation type on the NKRd and is managed under a Conservation Strategy with the U. S. Fish and Wildlife Service. Both agencies are currently working to update this agreement.

The primary threats to Montane/Subalpine Meadows are the lack of characteristic fire disturbance and limited nutrient cycling. Under the current disturbance regime and current rate of management, further departures are expected. Excessive ungulate pressure may also play a substantial role in some areas (KNF 2009). The Subalpine/Montane Meadows on the NKR are linear and as a result are at a higher risk of loss because trees encroach from the edges and the openings close more quickly. Kaibab Indian paintbrush, Kaibab bladderpod and Mt. Dellenbaugh sandwort are three FS Sensitive plant species in the Subalpine Grasslands of the NKR.

The Colorado Plateau/Great Basin Grasslands shows some degree of departure. This grassland type is greatly departed off-Forest. The primary threat is the lack of characteristic fire disturbance and limited nutrient cycling. Conifers are also encroaching. Excessive ungulate pressure may also play a substantial role in some areas (KNF 2009). Disturbed rabbitbrush is an important Forest planning plant species that is currently being affected by these changes.

Semi-desert Grasslands are much less abundant than they were historically, which reduces the amount of available habitat for grassland-associated species. Bigelow's onion grow in this vegetation type.

The Desert Communities occupy a proportionally small area of the Forest, but provide habitat for a number of unique and endemic plant species not found in other areas of the Forest. The primary threats to the Desert Communities are the invasion of exotic plant species such as Cheatgrass, and closed shrub states becoming more common. These threats increase the risk of uncharacteristic fire disturbance. This could further reduce native plant diversity and structure, increasing invasive plant cover and erosion. The US Fish and Wildlife Service Proposed rare cactus, Fickeisen plains cactus, as well as Utah and Kaibab agaves grow in the Desert Communities. Bebb's willow and Pond lily are two rare plant species on the Kaibab NF in Wetland/Cienegas PNVT. The primary threats are the lack of characteristic fire disturbance, limited nutrient cycling, and reduced water input (KNF 2009). Tree encroachment and high tree density in adjacent vegetation types may lower the water table and reduce water flow in this system. Fire disturbance under current conditions may lead toward invasive plants. Drought is a secondary threat.

The following is the key to the Forest rankings in Table 9

Forest Rank: F? (Information insufficient to develop rank);

F1 (Extremely rare on the forest);

F2 (Very rare on the forest);

F3 (Rare and uncommon on the forest)

F4 (Widespread abundant on the forest)

F5 (Demonstrably secure on the forest)

FP (Potential habitat on forest but species not known to occur)

FO (off forest)

Vegetation Types: CWR: Cottonwood-Willow Riparian Forest; DC: Desert Communities; GBG: Great Basin Grassland; MCA: Mixed Conifer with Aspen; MSM: Montane Subalpine Meadows; PJW: Pinyon Juniper Woodland; PPF: Ponderosa Pine Forest; SbS: Sagebrush Shrubland; SdG: Semi-desert Grassland; SFF: Spruce Fir Forest; W/C: Wetland / Cienega; W: Water.

Table 9. Forest Planning Plant Species list, Forest Ranks, and Associated Vegetation Types.

Scientific-Name	Common-Name	Forest Rank	Vegetation Types
<i>Actaea arizonica</i>	Arizona Bugbane	F1	MCA
<i>Agave utahensis</i> var. <i>kaibabensis</i>	Utah Century Plant	F1	PJW
<i>Agave utahensis</i> var. <i>utahensis</i>	Utah Agave	F2	DC
<i>Allium bigelovii</i> ¹	Bigelow's Onion	FO	DC,SdG
<i>Aquilegia caerulea</i> var. <i>pinetorum</i>	Colorado Blue Columbine, Columbine	F1	MCA,SFF
<i>Arenaria aberrans</i>	Mt. Dellenbaugh Sandwort	F1	MSM
<i>Asclepias hallii</i>	Hall's Milkweed	F1	PJW,PPF
<i>Asclepias quinqueidentata</i>	Slimpod Milkweed	F1	PPF
<i>Astragalus amphioxys</i> var. <i>modestus</i>	Alladin's Slippers	FO	PJW,SbS
<i>Astragalus ampullarius</i>	Gumbo Milkvetch	FP	DC,PJW
<i>Astragalus cremnophylax</i> var. <i>hevronii</i>	Hevron's Milkvetch	FP	DC
<i>Astragalus cremnophylax</i> var. <i>myriorrhaphis</i>	Cliff Milkvetch	F1	PJW
<i>Astragalus episcopus</i> var. <i>lancearius</i>	Lancer Milkvetch	F1	PJW,SbS
<i>Astragalus humistratus</i> var. <i>tenerrimus</i>	Groundcover Milkvetch	F3	PPF,SFF
<i>Astragalus lentiginosus</i> var. <i>oropedii</i>	Freckled Milkvetch	FP	PJW,PPF
<i>Astragalus lentiginosus</i> var. <i>vitreus</i>	Freckled Milkvetch	F?	PJW,SbS,GBG
<i>Astragalus pinonis</i> var. <i>atwoodii</i>	A Milkvetch	F1	PJW
<i>Astragalus rusbyi</i>	Rusby's Milkvetch	F1	MCA,PPF
<i>Astragalus subcinereus</i>	Silver Milkvetch	F2	PJW,SbS,PPF
<i>Astragalus titanophilus</i>	Limestone Milkvetch	FP	GBG
<i>Astragalus troglodytus</i>	Creeping Milkvetch	F1	PJW,SbS,PPF
<i>Botrychium echo</i>	Reflected Moonwort	FO	MSM
<i>Camissonia gouldii</i>	Diamond Valley Suncup	FO	PJW
<i>Carex oreocharis</i>	A Sedge	F1	MSM
<i>Castilleja kaibabensis</i>	Kaibab Indian-paintbrush	F1	MSM
<i>Chrysothamnus molestus</i>	Disturbed (Tusayan) rabbitbrush	F2	GBG,PJW
<i>Cirsium rothrockii</i>	Rose-color Thistle	FP	PPF
<i>Clematis hirsutissima</i> var. <i>hirsutissima</i> ²	Hairy Clematis	F1	PPF
<i>Cleome lutea</i> var. <i>jonesii</i>	Jones' Spider-flower	FO	CWRF,PJW
<i>Cordylanthus wrightii</i> ssp. <i>kaibabensis</i>	Wright's Bird's-beak	F1	PJW, PPF,SbS

¹ FS Sensitive species that do not occur on the Kaibab NF (FO or FP) are not carried forward for viability analysis.

<i>Cryptantha abata</i>	Dent-nut Cat's-eye	FO	PJW,PPF
<i>Cystopteris utahensis</i>	Utah Bladder Fern	F?	PJW,PPF
<i>Draba asprella</i> var. <i>asprella</i>	Rough Whitlow-grass	FO	PPF
<i>Draba asprella</i> var. <i>kaibabensis</i>	Rough Whitlow-grass	F1	PJW,PPF
<i>Draba asprella</i> var. <i>stelligera</i>	Rough Whitlow-grass	FO	PPF
<i>Draba rectifruta</i>	Mountain Whitlow-grass	F1	MCA
<i>Erigeron saxatilis</i>	Cliff Fleabane	F1	PPF
<i>Eriogonum corymbosum</i> var. <i>glutinosum</i> ²	Wild Buckwheat	FO	PJW,PPF
<i>Eriogonum darrovii</i>	Darrow's Wild Buckwheat	F1	GBG
<i>Eriogonum pulchrum</i> (= <i>Eriogonum ericifolium</i> var. <i>pulchrum</i>)	Yavapai Wild Buckwheat	FO	PJW,PPF
<i>Eriogonum jonesii</i>	Jones' Wild Buckwheat	F?	PJW
<i>Eriogonum mortonianum</i>	Morton Wild Buckwheat	FP	SbS
<i>Eriogonum thompsoniae</i> var. <i>atwoodii</i>	Atwood's Wild Buckwheat	FP	SbS
<i>Escobaria vivipara</i> var. <i>kaibabensis</i> ³	Spinystar	F5	PJW
<i>Gaillardia parryi</i>	Parry's Blanket-flower	F1	PJW
<i>Hedeoma diffusa</i>	Flagstaff Pennyroyal	F1	PPF
<i>Helianthus arizonensis</i>	Arizona Sunflower	FP	PJW
<i>Heuchera novomexicana</i>	New Mexico Alum-root	FP	PJW
<i>Ivesia arizonica</i> ⁴	Arizona Whitefeather	FO	PJW,PPF
<i>Ivesia arizonica</i> var. <i>arizonica</i>	Arizona Whitefeather	F?	PJW,PPF
<i>Lepidium montanum</i> var. <i>glabrum</i>	Mountain Pepperweed	FO	DC, PJW
<i>Lesquerella arizonica</i>	Arizona Bladderpod	F2	PJW,PPF
<i>Lesquerella kaibabensis</i>	Kaibab Bladderpod	F1	MSM
<i>Lotus mearnsii</i> var. <i>mearnsii</i>	Mearns Lotus	F?	DC,SdG
<i>Macromeria viridiflora</i> var. <i>viridiflora</i> ⁵	Giant-trumpets	F4	PPF
<i>Mertensia macdougallii</i>	Macdougall's Bluebells	F1	MWR,PPF
<i>Moneses uniflora</i>	Wood nymph	FO	MCA,PPF,SSF
<i>Myosurus nitidus</i>	Western Mouse-tail	F1	PJW,PPF
<i>Nuphar lutea</i>	Pond lily	F1	W

² Recent investigation revealed this taxa is more widespread and common than previously determined. No locations are documented for the Kaibab NF.

³ *Escobaria vivipara* var. *kaibabensis* is now included in *Coryphantha vivipara*, “the most widespread, abundant and variable member of the genus....”(Flora North America, p. 235-236). Not considered further in this analysis.

⁴ Not considered further because the variety on the Forest is var. *arizonica* (included in table).

⁵ Recent investigation revealed this taxa is more widespread and common than previously determined. NatureServe ranking G4?T3?. Not considered further in this analysis.

<i>Pediocactus paradinei</i>	Paradine Plains Cactus	F1	PJW,SbS
<i>Pediocactus peeblesianus</i> var. <i>fickeiseniae</i>	Fickeisen Plains Cactus	F1	DC
<i>Pediomelum mephiticum</i>	Skunk-top Scurfpea	FO	DC,PJW,SdG
<i>Penstemon caespitosus</i> var. <i>desertipicti</i>	Mat Penstemon	F2	PJW
<i>Penstemon laevis</i>	Southwestern Beardtongue	F1	PJW,PPF
<i>Penstemon nudiflorus</i>	Flagstaff Beardtongue	F1	PJW,PPF
<i>Penstemon pseudoputis</i>	Kaibab Beardtongue	F2	PPF, MSM
<i>Penstemon rydbergii</i> ⁶	Rydberg's Penstemon	F4	MSM
<i>Perityle congesta</i>	Compacted Rock Daisy	F1	PJW,PPF
<i>Perityle gracilis</i>	Grass-like Rockdaisy	F?	PJW
<i>Phacelia serrata</i>	Serrate Phacelia	FP	PJW,PPF
<i>Phemeranthus validulus</i> (= <i>Talinum validulum</i>)	Western Flame-flower	F2	PJW,PPF
<i>Phlox amabilis</i>	Arizona Phlox	F1	PJW,PPF
<i>Potentilla crinita</i> var. <i>lemmonii</i>	Bearded Cinquefoil	F2	PPF
<i>Ranunculus oreogenes</i>	Oregon Buttercup	F1	PPF
<i>Rosa stellata</i> ssp. <i>abyssa</i>	Grand Canyon Rose	F1	PJW,SbS
<i>Salix bebbiana</i>	Bebb's Willow	F1	W/C
<i>Shepherdia rotundifolia</i>	Roundleaf Buffaloberry	F1	PJW
<i>Sporobolus interruptus</i>	Black Dropseed	F?	MSM,PPF
<i>Stachys rothrockii</i>	Rothrock's Hedge-nettle	F?	PJW,PPF
<i>Thelypodopsis ambigua</i> var. <i>ambigua</i>	Long Valley Tumblemustard	FO	DC,PJW
<i>Thelypteris puberula</i>	Showy Maidenfern	FO	CWRF
<i>Triteleia lemmoniae</i>	Oak Creek Tritelleia	F?	PPF

Critical Habitat for Listed Plant Species

The forest has no designated critical habitat for plants at this time. However, the July 8, 2013 Federal Register has the proposed listing and designation of critical habitat for Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*). There is one CHU proposed for the Fickeisen plains cactus that is located on the North Kaibab Ranger District. The CHU 4 (South Canyon) is entirely located on the forest and contains 272 areas within the unit. The unit contains at least 62 individuals scattered among six areas along the rim of South Canyon Point.

Environmental Consequences to Plant Species Viability

The plant species viability assessment focuses on information relevant to the Kaibab National Forest. This evaluation used the Species Viability Process (described previously in this report under the Methodology and Analysis section) to identify species for which there are substantive risks to maintenance of viable

⁶ Recent investigation revealed this taxa is more widespread and common than previously determined. NatureServe ranking G4T5. Not considered further in this analysis.

populations, and to ensure consideration of appropriate habitat management strategies to reduce those risks to acceptable levels where feasible.

From the 81 plant species used as Forest Planning species, 53 species had a rating of F?-F3 (Table 9) and will be carried forward in this viability analysis. This list includes one federal listed species and 14 Regional Forester Sensitive Species known to occur on the Kaibab National Forest. Consequences unique to each alternative and the differences among the action alternatives for the Forest planning plant species are compared in Table 10. Ratings of risk to viability for each species/habitat relationship by alternative are also presented in the table.

The following is a key to variables used in Table 10 (see Appendix C for a more detailed description of the rating codes):

Status: F (Federally listed or proposed as Threatened or Endangered)

S (Regional Forester's sensitive species list)

O (locally rare & other)

F Rank: F? (information insufficient to develop rank);

F1 (extremely rare on the forest);

F2 (Very rare on the forest);

F3 (Rare and uncommon on the forest)

Viability Risk:

VH (Very High)

H (High)

MH (Moderately High)

M (Moderate)

L (Low)

As table 10 shows, the one listed species, 14 regional forester sensitive species, and 36 other forest plan analysis plant species were found to have at least one element ranked as a high rating risk category.

Table 10. Risk to species viability for each plant species/habitat relation by forest plan revision alternative.

Scientific Name	Common Name	Status	F Rank	Habitat element/feature	Viability Risk by Alternative			
					A	B	C	D
Actaea arizonica	Arizona bugbane	S	F1	Aspen within Mesic Mixed Conifers	H	H	H	H
				Canyons	MH	MH	MH	MH
Agave utahensis var. kaibabensis	Utah century plant	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Desert Communities	VH	VH	VH	VH
				Cliffs and ledges	MH	MH	MH	MH
Agave utahensis var. utahensis	Utah Agave	O	F2	Pinyon-Juniper Woodland	M	M	M	M
				Desert Communities	H	H	H	H

		Status	F Rank		Viability Risk by Alternative			
Scientific Name	Common Name			Habitat element/feature	A	B	C	D
				Cliffs and ledges	M	M	M	M
Aquilegia caerulea var. pinetorum	Columbine	O	F1	Aspen with Mesic Mixed Conifer and Spruce	H	H	H	H
				Seeps	H	H	H	H
Arenaria aberrans	Mt. Dellenbaugh Sandwort	S	F1	Montane Subalpine Grassland	H	MH	MH	MH
				Limestone soils	MH	MH	MH	MH
Asclepias hallii	Hall's Milkweed	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
Asclepias quinquedentata	Slimpod milkweed	O	F?	Ponderosa Pine	H	MH	H	H
Astragalus cremnophyllax var. myriorrhaphis	Cliff Milkvetch	S	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
Astragalus episcopus var. lancearius	Lancer Milkvetch	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Sagebrush Shrubland	MH	MH	MH	MH
Astragalus humistratus var. tenerrimus	Groundcover milkvetch	O	F3	Ponderosa Pine	M	L	M	M
				Spruce Fir Forest	M	M	M	M
Astragalus lentiginosus var. vitreus	Freckled milkvetch	O	F?	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Sagebrush Shrubland	MH	MH	MH	MH
				Great Basin Grassland	H	MH	MH	MH
Astragalus pinonis var. atwoodii	A Milk-vetch	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
Astragalus rusbyi	Rusby's Milk-vetch	S	F1	Aspen within Mesic Mixed Conifers	H	H	H	H
				Ponderosa Pine	H	MH	H	H
Astragalus subcinereus	Silver Milkvetch	O	F2	Pinyon-Juniper Woodland	M	M	M	M
				Sagebrush Shrubland	M	M	M	M
				Great Basin Grassland	MH	M	M	M
Astragalus troglodytus	Creeping Milk-vetch	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH

		Status	F Rank		Viability Risk by Alternative			
Scientific Name	Common Name			Habitat element/feature	A	B	C	D
				Sagebrush Shrubland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
Carex oreocharis	A Sedge	O	F1	Montane Subalpine Grassland	H	MH	MH	MH
Castilleja kaibabensis	Kaibab Indian-paintbrush	S	F1	Montane Subalpine Grassland	H	MH	MH	MH
Chrysothamnus molestus	Disturbed (Tusayan) rabbitbrush	S	F2	Great Basin Grassland	MH	M	M	M
				Pinyon-Juniper Woodland	M	M	M	M
				Calcareous soils	M	M	M	M
Clematis hirsutissima var. hirsutissima	Hairy clematis	S	F1	Ponderosa Pine	H	MH	H	H
				Dolomitic limestone soils	MH	MH	MH	MH
Cordylanthus wrightii ssp. kaibabensis	Wright's Bird's-beak	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Sagebrush Shrublands	MH	MH	MH	MH
Cystopteris utahensis	Utah Bladder Fern	O	F?	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Wet ground	H	H	H	H
				Cliffs and ledges	MH	MH	MH	MH
Draba asprella var. kaibabensis	Rough Whitlow-grass	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Cliffs and ledges	MH	MH	MH	MH
Draba rectifruta	Mountain Whitlow-grass	O	F1	Aspen within Mesic Mixed Conifers	H	H	H	H
Erigeron saxatilis	Cliff Fleabane	S	F1	Ponderosa Pine	H	MH	H	H
				Cliffs and ledges	MH	MH	MH	MH
Eriogonum darrovii	Darrow's Wild Buckwheat	O	F1	Great Basin Grassland	H	MH	MH	MH
Eriogonum jonesii	Jones' Wild Buckwheat	O	F?	Pinyon-Juniper Woodland	MH	MH	MH	MH

		Status	F Rank		Viability Risk by Alternative			
Scientific Name	Common Name			Habitat element/feature	A	B	C	D
Gaillardia parryi	Parry's Blanket-flower	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
Hedeoma diffusa	Flagstaff Pennyroyal	S	F1	Ponderosa Pine	H	MH	H	H
				Rocky dolomitic cliffs and ledges	MH	MH	MH	MH
				Limestone	MH	MH	MH	MH
Ivesia arizonica var. arizonica	Arizona Whitefeather	O	F?	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Rocky limestone	MH	MH	MH	MH
Lesquerella arizonica	Arizona Bladderpod	O	F2	Pinyon-Juniper Woodland	M	M	M	M
				Ponderosa Pine	MH	M	MH	MH
Lesquerella kaibabensis	Kaibab Bladder-pod	S	F1	Montane Subalpine Grassland	H	MH	MH	MH
				Rocky slopes	MH	MH	MH	MH
Lotus mearnsii var. mearnsii	Mearns lotus	O	F?	Semi-desert grassland	H	H	H	H
Mertensia macdougalii	Maddougal's Bluebells	O	F1	Montane Willow Riparian Forest	H	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
Myosurus nitidus	Western Mouse-tail	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Seasonally wet ground	H	H	H	H
Nuphar lutea	Pond lily	O	F1	Water	H	H	H	H
Pediocactus paradinei	Paradine Plains Cactus	S	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Sagebrush Shrubland	MH	MH	MH	MH
				Limestone soils	MH	MH	MH	MH
Pediocactus peeblesianus var. fickeiseniae	Fickeisen Plains Cactus	F	F1	Desert Communities	VH	VH	VH	VH
				Limestone soils	MH	MH	MH	MH
Penstemon caespitosus var. desertipicti	Mat Penstemon	O	F2	Pinyon-Juniper Woodland	M	M	M	M
Penstemon laevis	Southwestern Beardtongue	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH

		Status	F Rank		Viability Risk by Alternative			
Scientific Name	Common Name			Habitat element/feature	A	B	C	D
				Ponderosa Pine	H	MH	H	H
Penstemon nudiflorus	Flagstaff Beardtongue	S	F1 ?	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Basalt soils	MH	MH	MH	MH
Penstemon pseudoputus	Kaibab Beardtongue	O	F2	Ponderosa Pine	MH	M	MH	MH
				Montane Subalpine Grassland	MH	M	M	M
Perityle congesta	Compacted Rock Daisy	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Limestone	MH	MH	MH	MH
				Cliffs and ledges	MH	MH	MH	MH
Perityle gracilis	Grass-like Rockdaisy	O	F?	Pinyon-Juniper Woodland	MH	MH	MH	MH
Phemeranthus validulus =Talinum validulum	Western Flame-flower	O	F2	Pinyon-Juniper Woodland	M	M	M	M
				Ponderosa Pine	MH	M	MH	MH
				Seasonally wet	MH	MH	MH	MH
				Limestone soils	M	M	M	M
Phlox amabilis	Arizona Phlox	S	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Limestone soils	MH	MH	MH	MH
Potentilla crinita var. lemmonii	Bearded Cinquefoil	O	F2	Ponderosa Pine	MH	M	MH	MH
Ranunculus oreogenes	Oregon Buttercup	O	F1	Ponderosa Pine	H	MH	H	H
Rosa stellata ssp. abyssa	Grand Canyon Rose	S	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Sagebrush Shrubland	MH	MH	MH	MH
				Limestone	MH	MH	MH	MH
				Cliffs and ledges	MH	MH	MH	MH
Salix bebbiana	Bebb's willow	O	F1	Wetland/Cienega	VH	VH	VH	VH
Shepherdia rotundifolia	Roundleaf Buffaloberry	O	F1	Pinyon-Juniper Woodland	MH	MH	MH	MH
Sporobolus	Black Dropseed	O	F1	Montane Subalpine Grassland	H	MH	MH	MH

Scientific Name	Common Name	Status	F Rank	Habitat element/feature	Viability Risk by Alternative			
					A	B	C	D
interruptus				Ponderosa Pine	H	MH	H	H
Stachys rothrockii	Rothrock's Hedge-nettle	O	F?	Pinyon-Juniper Woodland	MH	MH	MH	MH
				Ponderosa Pine	H	MH	H	H
				Sandstone	MH	MH	MH	MH
Triteleia lemmoniae	Oak Creek Triteleia	O	F?	Ponderosa Pine	H	MH	H	H
				Wet soils	H	H	H	H

As Table 11 shows, the 1 listed species, 14 Regional Forester sensitive species and 36 other Forest Plan Analysis plant species were found to have at least one element ranked as a “high rating” risk category.

Table 11. Number of species/habitat relationships rated as very high, high, and moderately high risk to plant species viability for each category of management effect by forest plan revision alternative.

Management Effect/Risk	Alternatives			
	A	B	C	D
1. Provide Optimal Protection and Management for all Habitat Occurrences				
Very High	0	0	0	0
High	0	0	0	0
Moderately High	0	0	0	0
Total	0	0	0	0
2. Improve Habitat Abundance and Distribution Through Restoration				
Very High	0	1	1	1
High	0	5	5	5
Moderately High	0	28	7	7
Total	0	34	13	13
3. Maintain Habitat Abundance and Distribution				
Very High	3	2	2	2
High	49	15	36	36
Moderately High	48	42	46	46
Total	100	59	84	84
4. Reduce Habitat Abundance and distribution as Result of External Factors				
Very High	0	0	0	0
High	1	1	1	1
Moderately High	0	0	0	0
Total	1	1	1	1
5. Decline in Habitat Abundance and distribution as Result of Management				
Very High	0	0	0	0
High	0	0	0	0

Management Effect/Risk	Alternatives			
	A	B	C	D
Moderately High	0	0	0	0
Total	0	0	0	0
Total for all Management Effect Categories				
Very High	3	3	3	3
High	50	21	42	42
Moderately High	48	70	53	53
Total	101	94	98	98

Table 11 shows that Alternative B would provide habitat improvement for 34 habitat relationships, almost three times as many as would alternatives C and D. No alternative would provide optimal protection and management for all occurrences to habitat relationships that were ranked as VH, H and MH. However, all the other species, except one, which is affected by external factors, would have habitat abundance and distribution maintained. No species would suffer a decline in habitat abundance and distribution resulting from management under any of the alternatives. Alternative A would not provide improvement of habitat, but habitat abundance and distribution would be maintained.

Table 12 summarizes species with a “high rating” and their associated status by each planning alternative. The species status highlights the relative role of other provisions included in law and policy that result in additional consideration for at-risk species during planning. Only the highest rating for each species for each alternative is shown.

Table 12. Number of species rated as very high, high, and moderately high risk to plant species viability for each category of species status, by forest plan revision alternative.

Management Effect/Risk	Alternatives			
	A	B	C	D
Federal Listed Species				
Very High	1	1	1	1
High	0	0	0	0
Moderately High	0	0	0	0
Total	1	1	1	1
Regional Forester's Sensitive Species				
Very High	0	0	0	0
High	10	2	5	5
Moderately High	4	10	7	7
Total	14	12	12	12
Rare and Endemic Species				
Very High	2	2	2	2
High	24	8	22	22
Moderately High	10	23	12	12
Total	36	33	36	36
Total for all Management Effect Categories				
Very High	3	3	3	3
High	33	10	27	27
Moderately High	14	33	19	19

Total	50	46	49	49
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There are 50 Forest Plan Analysis plant species that have at least one habitat element with one of the three high rankings to viability risk. The other three Forest Plan Analysis plant species had risk ratings of low to moderate and are not shown in the table. Forest Plan Analysis species have lower risk ratings under Alternative B, than under action Alternatives C and D, and no-action Alternative A.

Environmental Consequences for Botanical Resources Common to All Alternatives.

Planning for, and evaluation of, species viability for forest plan revision has focused primarily on providing desired abundance and distribution of habitat elements, in compliance with NFMA regulations. Risks to species viability can be much further reduced by additional provisions present in existing law, regulation and policy. These include specific consideration of effects to federally listed threatened and endangered species, those proposed for such listing, and Regional Forester's Sensitive Species. These effects are disclosed in biological assessments and evaluations conducted as part of all national forest management decisions. These assessments and evaluations identify where additional protective measures are warranted to provide for continued existence of the species on national forest land. Projects that may affect federally listed or proposed species must be coordinated with the US Fish and Wildlife Service (FWS).

In support of these requirements, these species are often the focus of inventory and monitoring efforts. Additional species-based provisions included in all forest plan revision alternatives supplement existing law and policy. Many of the high risk species will be conserved through rare community requirements included in this Forest Plan, as well as through forest-wide objectives related to forest health and community restoration. All alternatives would continue to manage the Arizona Bugbane and Paradine Plains Cactus Botanical Areas to prevent further listing of that species.

Five habitat elements emerged as having a high likelihood of being a limiting factor for all alternatives. These include desert communities, Gambel oak shrublands, wetland/cienega, riparian forest, and cottonwood-willow riparian forest. All of these habitat elements naturally occur on less than 1 percent of the landscape across the Kaibab NF. It is not the forest intent to make these naturally rare habitat features more common than they were historically. For most of the species listed in table 22, their habitat elements may be common on the Kaibab NF, but the species are naturally limited in abundance or distribution due to micro-habitat needs. For these species, it is not the intent of the forest to increase their populations outside of areas they would naturally occur.

There would be continued treatment of noxious and/or non-native invasive plants under all alternatives. Recreation, livestock grazing, special uses, mining and minerals development, and energy development would continue to occur under all alternatives. These actions would follow manual and handbook policy and direction. Livestock grazing under the all alternatives would provide for continued availability of forage for domestic livestock. Operating instructions for livestock grazing permittees are reviewed annually. Because an adaptive management strategy is used to adjust use with capacity and minimize any adverse effects, the consequences associated with continued grazing use is minimal (KNF 2013c).

In addition to following existing law, regulation, and policy as mentioned above, projects would implement best management practices (BMPs) (FSM2530.2) and other mitigation measures designed to protect soils and watershed resources. BMPs and soil and water conservation practices (SWCPs) (FSH

2509.22 R3, FS-990a) have been designed to mitigate ground disturbance from forest mechanical treatments and these practices would help to mitigate any potentially negative impacts and would provide for viability of botanical resources affected by large-scale disturbance. See the Soils and Watershed section for additional information

The Grand Canyon Game Preserve which occurs on portions of the North Kaibab RD was established by presidential proclamation. No mining or minerals development is allowed in that area as a result of this designation. This would afford some protections from threats associated with mining activity for those species which occur in that area, including Fickeisen Plains cactus and Paradine Plains cactus.

Environmental Consequences for Botanical Resources for Alternative A - Current Plan, Current Management (No Action)

Alternative A has the greatest number of species with risk to viability from each category of management effect (50 total) that rate out in a very high (3), high (33), or moderate to high (14) viability risk rating (Table 12).

If Alternative A is selected, there would be no change in management actions on the Kaibab NF. The current Forest Plan was approved in 1988 and has been amended several times. Many of the rare plant species that were identified in the Plan in 1988 are no longer considered rare due to new information that has been gained from floristic surveys or project specific surveys. The current R3 Sensitive Species list (USDA Forest Service 2013) is used for surveys and input to projects. Information on other rare plant species, such as the analysis species used in the current planning process, would not be gathered under Alternative A.

Alternative A would continue to address uses and resources separately without recognition of interrelationships. Management direction would be lacking when guidance is needed to deal with more complex situations such as those arising after uncharacteristic wildfires. Several rare plants occur in areas that have been affected by wildfires, such as the Warm Fire. In the current forest plan, desired conditions are missing for land management areas and are either missing or inadequate at guiding projects in many of the Forest's vegetation types and Special Areas. The current Plan does not integrate desired disturbance processes and is typically written in terms of standards and guidelines, rather than desirable conditions to move toward.

The current plan does not acknowledge or attempt to address climate change. It fails to emphasize the restoration of natural ecological processes and ecosystems that will be resilient to such change. Related to climate change is an increased likelihood for large scale disturbance events (e.g. bark beetle outbreaks, widespread uncharacteristic fire and drought). The current plan offers little direction for management activities and botanical resources associated with large scale disturbance, but would continue to provide for species viability in the ways mentioned under "Environmental Consequences Common to All Alternatives". Under Alternative A, objectives would continue to be focused on outputs, rather than progress toward desired conditions. The Priority Needs for Change have been identified as: modifying stand structure and density towards reference conditions and restoring historic fire regimes; protecting and regenerating aspen; protecting natural waters; and restoring grasslands and meadows. These priorities are important for insuring viability of many rare plant species and would not be met under Alternative A. Many rare plant species occur in vegetation types that lack characteristic fire disturbance. Aspen regeneration is a concern for species associated with the Mesic Mixed Conifer vegetation type. The current Forest Plan offers little guidance for managing springs and ephemeral wetlands, which are rare and ecologically important resources. Actions to protect natural waters are relatively inexpensive and

easy to accomplish, provide important benefits, and have a high concordance with social and economic needs.

Standards and Guidelines (S&Gs) under Alternative A would not support attaining desired conditions or accomplishing objectives. The S&Gs are often very prescriptive about how to accomplish a project instead of focusing on the project outcome and read as more of a “one size fits all approach” leaving little management flexibility with regard to variation among site specific conditions, and limited ability to respond to emerging threats such as climate change. The S&Gs under Alternative A provide minimal guidance for mineral exploration and development, a potential threat to Fickeisen plains cactus, (Federally endangered species), as well as other rare plant taxa (e.g. Utah century plant, Utah agave, and Grand Canyon rose).

In Alternative A, S&Gs are based on outdated science and information about rare plant species. Much has been learned over the past 23 years and methods of communication via computers and internet have made much more information (such as plant locations and habitat data through SEINet) readily available for use. Retention of current S&Gs under Alternative A might result in conflicts with direction currently in FS handbooks and manuals, and strategies for conserving plant species such as Arizona bugbane and Paradine plains cactus.

Monitoring under Alternative A focuses on outputs, rather than effectiveness and progress toward desired conditions.

The current plan has very few standards or guidelines that relate directly to features needed by sensitive species that depend on grasslands, meadows, shrublands, desert communities, caves and mines, rocky outcrops, or cliffs and canyons. These species and features are indirectly affected by standards and guidelines for recreational uses and mineral development. Their main protection is the requirements to protect sensitive species which are addressed outside the plan. Recreation, livestock grazing, special uses, mining and minerals development, and energy development would continue to occur under Alternative A.

In addition, Alternative A does not have the guidelines (present for Alternatives B, C and D) that “project design should incorporate measures to protect and provide for rare and narrow endemic species where they are likely to occur”.

The current plan would continue to address invasive species through a forest-wide standard that “incorporates measures to control invasive species into project planning, implementation and monitoring”. In addition, a guideline which incorporates “Design Features, Best Management Practices and Mitigation Measures” in the “Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds on the Coconino, Kaibab, and Prescott NFs within Coconino, Gila, Mojave, and Yavapai Counties, Arizona” (USDA Forest Service 2005) would further help to mitigate the threatened posed by invasive plants.

Environmental Consequences for Botanical Resources Common to the Action Alternatives B, C, and D

The organization of the Proposed Plan and Alternatives is better integrated across resource areas than the current Forest Plan (Alternative A). Since monitoring is needed that supports adaptive management, focusing on outcomes and progress toward desired conditions rather than outputs, this aspect of the action alternatives is a particularly positive benefit for the Forest Plan Analysis plant species. Specifically, the monitoring plan addresses botanical resources through the following questions:

- Natural waters: In treated/protected areas, are water flow patterns and vegetation intact?

- Threatened and Endangered species: What is the population trend of *Pediocactus peeblesianus* var. *fickeisenii*?
- Pediocactus Conservation Area: Were the monitoring requirements met as identified in the Pediocactus conservation agreement?
- Arizona Bugbane Botanical Area: Were the monitoring requirements met as identified in the AZ Bugbane conservation agreement?
- Nonnative Invasive Species: What is the areal extent of priority nonnative invasive plants on the Kaibab NF?

The Action Alternatives articulate clear desired conditions for habitats and refugia for narrow endemics or species with restricted distributions and/or declining populations, including desired conditions that locations and conditions of rare and narrow endemic species are known, and habitat and refugia are present for narrow endemics or species with restricted distributions and/or declining populations. There is also a Guideline: “Project design should incorporate protective measures to provide for rare and narrow endemic species where they are likely to occur.” These desired conditions and guideline provide more direction under all the action alternatives for the 33 rare and endemic plant species being carried forward as forest planning species than does the current plan (no action alternative A) and will help to insure the viability of these species. Existing management areas such as the Arizona Bugbane Botanical Area and the proposed Pediocactus Conservation Area, as well as the conservation agreements for Paradine plains cactus and Arizona bugbane, provide for management and guidance for these rare endemic plants.

Bill Williams Mountain has been identified as a Management Area (MA) because it contains multiple resources and uses of high natural, cultural, and economic value. The establishment of the Bill Williams Mountain LMA would provide guidance over a wider area surrounding the Arizona Bugbane Botanical Area by establishing desired conditions that provide quality habitat for Arizona bugbane, guidelines that restrict commercial plant collection, and restrictions on the existing term permit for the Elk Ridge Ski Area.

Modifying stand structure and density toward reference conditions and restoration of historic fire regimes would enhance habitats of rare plant species. There are 29 forest plan analysis plant species that reside in the pinyon-juniper woodlands, and 25 forest plan analysis plant taxa grow in the ponderosa pine forest.

Desired conditions for the pinyon-juniper woodlands that provide for composition, structure and function of the vegetative conditions resilient to the frequency, extent, and severity of disturbances would be important to plant species such as Paradine Plains cactus, disturbed rabbitbrush, cliff milkvetch, Kaibab beardtongue, and western flameflower, species are currently affected by changes and threats to the pinyon-juniper woodlands. Even the rare Paradine Plains cactus is able to withstand moderate fire.

Studies of several forest planning species of the ponderosa pine forest, Rusby milkvetch (Springer et al., in press), Flagstaff pennyroyal (Phillips et al. 1992), and hairy clematis (Maschinski et al. 1997) have shown that these species respond favorably to treatments that open the ponderosa pine forests and restore more natural fire return intervals.

Field observations of other rare plant species such as Flagstaff beardtongue indicate positive responses to fire. Under the group selection matrix thinning, multi-storied, uneven-aged states are created more effectively (see Vegetation, Fuels and Fire section of this chapter). Since these states are more like the desired condition for the ponderosa pine PNVT, the habitats of many of the rare and endemic plant

species that evolved under more open forests with frequent low-intensity ground fires would be enhanced under this alternative.

All the alternatives have emphasizes for aspen regeneration to insure long-term healthy aspen populations and to provide local habitat diversity and scenery. This would be particularly favorable in the long term to several plant species: Arizona bugbane, columbine, Rusby milkvetch, and mountain whitlow-grass. On the Williams Ranger District, where the Arizona Bugbane Botanical Area occurs on Bill Williams Mountain, there has been very little successful regeneration of aspen. Aspen trees die after severe frost events weaken them, leaving them susceptible to infestations of secondary agents including cytospora canker, bronze poplar borer, and other canker fungi and insects (Fairweather 2006, personal communication). However, some negative short-term impacts could result during project implementation such as trampling and crushing associated with implementation of fencing and conifer reduction projects.

Kaibab Indian paintbrush, Kaibab bladderpod, and Mt. Dellenbaugh sandwort are three Forest Service sensitive plant species in the subalpine meadows of the North Kaibab Ranger District. The preferred alternative's priority need for change aimed at restoring historic meadows by reducing tree encroachment and restoring fire could be beneficial to forest plan analysis plant species in this vegetation type. The subalpine meadows are likely to be affected by climate change since they are a relict vegetation type from cooler wetter Pleistocene Ice Ages. Improving the extent and quality of the habitat to allow native species to occur in natural patterns of abundance, composition and distribution, with maintenance and improvement of water infiltration, nutrient cycling, and soil productivity, would be beneficial to these species. The management approach of diffusing grazing pressure from elk and livestock will enhance the rare endemic plant species in these vegetation communities as well. The guideline, "Heavy equipment and log decks should not be staged in montane meadows," will protect the habitat of the above species as well as Tusayan flameflower, a forest plan analysis species that is present in montane meadows, but difficult to locate during much of the year due to its small stature and cryptic nature.

Uncharacteristic fire is also a threat to the habitat of Arizona bugbane in the botanical area due to very little successful regeneration of the aspen and dying off of large old-growth conifers. Aspen trees die off after severe frost events weaken them. This is followed by infestations of secondary infectious agents including cytospora canker, bronze poplar borer, and other canker fungi and insects (Fairweather 2006, personal communication). An objective for the Bill Williams Mountain LMA is to implement a fuels reduction project within 5 years of plan approval. Arizona bugbane has shown resilience to moderate fire and responds favorably to the resulting increase in nitrogen, bare soil, and opening of the forest canopy for regeneration (Phillips and Crisp 2010).

The establishment of the *Pediocactus* Conservation Area would aid in the management of Paradine Plains cactus by providing plan direction for the area encompassing this rare cactus. Paradine Plains cactus is managed under a conservation assessment and strategy developed by the Forest Service, Bureau of Land Management, and U.S. Fish and Wildlife Service (USDA et al. 1997). Paradine Plains cactus is very small, occurs in colonies and withdraws underground during dry conditions, making it extremely difficult to locate during much of the year. Evaluating potential ground-disturbing activities in the *Pediocactus* Conservation Area and implementing protective measures as needed would help protect the species. Restricting motorized access would reduce impacts from vehicles and the associated uses of the area by people (campsites, social trails, etc.) on the plants and habitat. Cheatgrass is an on-going threat to the Paradine Plains cactus and its habitat because this nonnative annual grass changes the fire return interval to more frequent than would occur under natural conditions. High-severity fires are lethal to Paradine Plains cactus, as the Warm Fire has shown. Treating invasive nonnative plants would reduce direct competition with invasive plants and reduce the potential of the indirect effects of fire mortality and alteration of plant species and the cactus' colonizing soil mycorrhizae, which are essential for the health

of the plants. Since plant collection is a serious threat to Paradine Plains cactus, de-emphasizing the species in forest literature would be helpful.

Recreation, livestock grazing, special uses, mining and minerals development, and energy development would continue to occur under all alternatives. However, the action alternatives (B, C and D) have the guideline that project design should incorporate protective measures to provide for protection of rare and narrow endemic plant species where they are likely to occur, and that “project activities and special uses should be designed and implemented to maintain refugia and critical life cycle needs of Forest Service Sensitive Species”. These guidelines would help maintain species viability from Kaibab NF management activities.

Guidelines for minerals and mining also specify that surface use should be restricted or prohibited in areas with habitat for threatened, endangered, and sensitive plant and animal species and use and occupancy should be restricted yearlong in areas supporting populations of threatened, endangered, and sensitive plant species. In addition, guidelines for cliffs and rocky features specify that “where recreation activities have the potential to trample known populations of narrow and endemic plant species, signs should be posted educating the public to stay on designated trails and avoid impacts”, and “talus slopes should be surveyed for endemic species prior to authorizing quarrying, rock hounding, or construction activities that may alter them. The specificity is lacking under Alternative A.

The expected relative significance of the implementation of the action alternatives plan decisions within the context of the greater landscape would be a slight increase in available forage with minimal consequences to other resources (KNF 2013d). Thus some rare and endemic plants, such as Disturbed rabbitbrush and the subalpine meadow species that incur grazing pressures would benefit under the action alternatives.

Uncharacteristic wildfire and the associated threat of competition from nonnative invasive species, is a threat to some species, especially those in Desert Communities. Under the action alternatives, guidelines under Wildland Fire Management help to mitigate this threat: “Actively growing wildfires in the Desert Community vegetation type in Kanab Creek Wilderness should be suppressed”, and a forest-wide guideline to “Evaluate the risk of cheatgrass invasion. When there is a moderate to high risk of cheatgrass invasion, mitigation measures should be developed. If adequate treatments are not available, or if they are cost-prohibitive, objectives to minimize the burned area should be developed”. These guidelines provide stronger and more specific plan direction emphasizing wildfire and cheatgrass invasion than the current plan (alternative A) and would benefit numerous species including Fickeisen plains cactus.

Under the action alternatives, there is more explicit plan direction to address invasive species, than under Alternative A. There is an objective to treat 2,000 to 3,000 invaded acres annually. Forest wide guidelines further specify that all ground-disturbing projects should assess the risk of noxious weed invasion and incorporate measures to minimize the potential for the spread of noxious and invasive species. New populations should be detected early, monitored, and treated as soon as possible, and treatment approaches should use integrated pest management (IPM) practices to treat noxious and nonnative invasive species. IPM includes manual, biological, mechanical, and herbicide/pesticide treatments.

Under the action alternatives, there is more explicit plan direction to address the bison herd on the North Kaibab Ranger District. Guidelines specify that the bison herd should be managed so it is concentrated within the House Rock Wildlife Management Area, and that active management should be used to

minimize impacts from bison to sensitive resources, particularly outside the House Rock Wildlife Management Area. Management of the bison herd under these guidelines will reduce potential damage to sensitive plant species and habitats caused by the bison, and decrease the spread of nonnative invasive species.

The action alternatives acknowledge and better address climate change than the current plan (Alternative A) by providing for resilient ecosystems that will be better able to withstand large-scale disturbance events such as drought and uncharacteristic fire. These disturbances have the ability to affect numerous ecosystems and plant habitat. Some forest management activities that would respond to such events like salvage logging could have negative direct (e.g. incidental crushing and trampling of plants) as well as indirect effects on plants (e.g. impacts to soil hydrologic function, soil stability, and nutrient cycling, as well as an increase in non-native invasive plant competitors) resulting from ground disturbance through mechanical harvest and restoration treatments

During management activities that respond to large-scale disturbance events, the Forest would mitigate threats for listed, sensitive and rare and narrow endemic plant species through the specific plan components that follow below, and also through appropriate BMPs and SWCPs as mentioned above in “Environmental Consequences Common to All Alternatives”. Alternatives B, C, D include a forest-wide strategy with specific guidelines and objectives to address management activities and large scale disturbances in forest and woodland communities. Specific guidelines that would provide for plant viability include: Recovery and restoration project design should seek to establish a trajectory toward the desired conditions for the affected vegetation type; erosion control measures should be implemented to protect significant resource values and infrastructure such as stream channels, roads, structures, and archaeological or historic sites; practices that restore nutrient cycling and stabilize soils (revegetation, mulching, lop and scatter, etc.) should be implemented; some snags and coarse woody debris should be retained to provide for wildlife habitat, soil stabilization, and other resource benefits; and project design should incorporate measures to protect regeneration and reforestation investments.

The guidelines for large-scale disturbance are in addition to existing law, regulation and policy and relevant plan direction (e.g. desired conditions for the respective vegetation types, guidelines for vegetation management in forested communities, guidelines for rare and narrow endemics, guidelines and objectives for non-native invasive species etc...).

Wetlands, including perennial waters and ephemeral waters have desired conditions to support healthy native plant species with an objective to restore native vegetation and natural water flow patterns on at least six acres of wetlands within five years of plan approval. Similarly, natural waters which include perennial and ephemeral springs have desired conditions to maintain self-sustaining plant species that occur in natural patterns of abundance and distribution, unwanted nonnative species do not exert a detectable impact on aquatic and wetland ecosystems, hydrophytes and emergent vegetation exist in patterns of natural abundance in wetlands and springs in levels that reflect climatic conditions, and overhanging vegetation and floating plants such as water lilies exist where they naturally occur. Objectives for natural waters include the protection and restoration of at least ten individual springs within five years of plan approval. These plan components would support plants that used these habitats including Bebb’s willow, Pond Lily, Columbine, and Western Flame flower.

Finally, a Management Approach under all the action alternatives is to provide species-specific information and management recommendations in a Kaibab endemic plant species guidebook that will be maintained as a living document, updated with new information and locations as they become available. This guidebook will provide in one document a substantial amount of information on the species and its population biology, ecology, habitats, locations, and threats and effects of management actions. It will

also provide management actions and opportunities which will be useful for project planning and implementation for all resource specialists.

Environmental Consequences for Botanical Resources: Alternative B–Preferred Alternative

Alternative B has the lowest number of species and associated habitat elements (46 total) that rate out in a very high (3), high (10), or moderate to high (33) viability risk rating (Table 12). Alternative B is the Preferred Alternative.

Desired conditions are based on the best scientific information available that describes reference conditions for the different vegetation types of ponderosa pine, mixed conifer, and woodlands and savannas. Alternative B is the alternative that would set these vegetation types on a trajectory that would be most likely to achieve reference conditions. Restoring habitat elements to reference conditions or at least toward reference conditions should provide for viable species populations for those species that evolved within these systems.

Two of the current four Kaibab NF wilderness areas, Kanab Creek Wilderness and Saddle Mountain Wilderness, have proposed wilderness additions under the Preferred Alternative. Some rare endemic plants are known to occur or to have potential habitat along the rims of Kanab Canyon. Designating these lands as Wilderness could afford the rare and endemic plants that occur within those areas additional protection from disturbances. The area of the Cockscomb that is proposed to be added to the Saddle Mountain Wilderness has not had a thorough floristic inventory. This area may have potential habitat for endemic plants. As lands are designated as “Wilderness,” they would become closed to any new mineral leases and new mineral materials pits. As the existing materials pits within the Recommended Wilderness areas become depleted or are no longer needed they would be closed. These actions would enhance protection for rare and endemic plant species and reduce the risk of non-native noxious and/or invasive plant invasions. However, limited ability to access the wilderness areas could result in more difficulties controlling invasive plants that coincide with rare plant habitats in those areas.

According to the Non Native Invasive Species Specialist Report (KNF 2013c) Alternative B is the most beneficial for preventing and controlling invasive species. The preferred alternative proposes the highest amount of vegetation treatments and planned disturbance out of the four alternatives, thereby creating the highest risk of the spread/introduction of invasive species. However, it also generates the highest potential for long term native understory enhancement. This in turn increases the ability of native species to out-compete invasive species over the long term, and further decreases susceptibility to uncharacteristic fire.

Rare and sensitive species may be especially vulnerable to climate change under all alternatives because they often need specific habitat components that are not widely available. The North Kaibab subalpine meadows may become vulnerable as elevational vegetation shifts occur (USDA Forest Service 2010). Future plant distributions in general may be governed by several factors including human influences, abilities of plants to disperse, and the presence of suitable habitat components including such factors as suitable soil types and presence of pollinators (McKenney et al. 2007). Large changes in ecosystem structure and species composition of plant communities are expected due to increasing temperatures and altered precipitation cycles (USDA Forest Service 2010). The specific effects of the factors of climate change on local plant communities and forest plan analysis plants growing in them are not known; however, the beneficial effects of alternatives B, C, and D would slightly counteract the larger effects of global climate change by reducing the vulnerability of sensitive plant populations to additional disturbance. Guidance under alternative B does the best job of addressing climate change by managing for

ecosystems which will be resilient to change, and allowing for more site-specific management flexibility. This will allow the forest to better cope with, and adapt to, the changing needs of rare plants and their associated habitats.

Environmental Consequences for Botanical Resources: Alternative C

Alternative C and D have more species at risk from management than Alternative B (preferred alternative), but less than Alternative A (no action alternative) with 49 total that rate out in a very high (3), high (27), or moderate to high (49) viability risk rating (Table 12).

The North Kaibab Wildlife Habitat Complex is an area on the North Kaibab Ranger District of approximately 265,000 acres proposed under Alternative C. This LMA contains the Kaibab Squirrel National Natural Landmark and eight linked ephemeral riparian valleys and canyons. This LMA would include approximately half of the Pediocactus Conservation Area (the portion north of Highway 89 A and west of the East Side Game Road). In this management area, once forest structure is restored it would primarily be maintained with fire so there would be less area in the vegetative desired condition than under Alternative B, and there would be a greater risk of density dependent uncharacteristic disturbance, such as active crown fire (KNF 2013a). This trend away from the desired condition for the ponderosa pine PNVT would be less desirable for many of the rare and endemic plant species that evolved under more open multi-storied, uneven aged forests with frequent low intensity ground fires. This is reflected in table 10 whereby rare plants in the ponderosa pine PNVT show a lower viability risk under Alternative B than under Alternatives C and D; and in Table 11 where the species in the ponderosa pine PNVT under Alternative B show moderately high habitat improvement of habitat abundance and distribution through restoration whereas those species have only habitat abundance and distribution maintained under alternatives C and D. According to the effects of vegetation modeling, the matrix thinning is more effective at creating multi-storied, uneven aged states than treatments with an imposed diameter cap (Alternatives C and D) (KNF 2013a).

In addition to the recommended wilderness additions to the Kanab Creek and Saddle Mountain Wildernesses in the Preferred Alternative (B), Alternative C proposes six new Wilderness areas: Burro Canyon, Coconino Rim, Big Ridge, Seegmiller, South Canyon Point, and Willis Canyon. This alternative also contains an area (~1000 acres) contiguous to a potential wilderness addition to the Sycamore Wilderness on the Prescott National Forest's recommended wilderness areas. Flagstaff Pennyroyal and Cliff Fleabane are known within the current boundaries of the Sycamore Wilderness and Flagstaff Beardtongue occurs on top of the rims. Expansion of the boundaries on both the Kaibab and the Prescott NFs might include more habitat for these FS Sensitive plant species. The wilderness areas proposed for the NKRd could result in additional protections for Fickeisen Plains Cactus and perhaps other Forest Plan Analysis plant species such as Utah Century Plant, and Hevron's Milkvetch. However, limiting ways to access the wilderness areas, and ability to use certain equipment, could result in more difficulties controlling invasive plants in rare plant habitats.

Environmental Consequences for Botanical Resources: Alternative D

Alternative D was developed in response to the issue that "the effects associated with regular mechanical disturbance outweighs the benefits. Restoring the natural fire regime to forested landscapes provides greater overall benefit to ecosystems, communities, and economies."

Alternative D is similar to the Alternative C, except that the guideline "Following restoration the desired conditions should be maintained by restoring the natural fire regime" would apply to the entire forest, and

no new LMA would be established. This alternative would also include the same Proposed Wilderness Areas and tree retention guideline as Alternative C, with the same benefits and risks.

Summary

The Preferred Alternative, Alternative B, would provide habitat improvement for 34 habitat relationships, almost three times as many as would alternatives C and D. Table 11 shows that the species in the Ponderosa Pine PNV show moderately high improvement of habitat abundance and distribution through restoration under Alternative B whereas those species have only maintenance of habitat abundance and distribution under alternatives C and D. Rare plants in the Ponderosa Pine PNV show a lower viability risk under Alternative B than under Alternatives C and D (Table 10) because once forest structure is restored under alternatives C and D it would primarily be maintained with fire so there would be less area in the vegetative desired condition than under Alternative B, and there would be a greater risk of density dependent uncharacteristic disturbance, such as active crown fire (KNF 2013a). This trend away from the desired condition for the Ponderosa pine PNV would be less desirable for many of the rare and endemic plant species that evolved under more open forests with frequent low intensity ground fires.

All the other species except one would have habitat abundance and distribution maintained. Alternative A would not provide improvement of habitat, but habitat abundance and distribution would be maintained. In addition to the desired conditions and standards and guidelines developed for many different resource values, the action alternatives establish desired conditions for habitats and refugia for narrow endemics or species with restricted distributions and/or declining populations, and establishes a desired condition that locations and conditions of rare and narrow endemic species are known. The guideline that “Project design should incorporate measures to protect and provide for rare and narrow endemic species where they are likely to occur,” would facilitate attainment of these desired conditions. These desired conditions and guidelines provide more direction for the 33 rare and endemic forest planning plant species than does the Current Plan (No Action Alternative A). Other provisions included in law and policy result in additional considerations for at-risk species during planning.

Existing management areas such as the Arizona Bugbane Botanical Area and the proposed Pediocactus Conservation Area, as well as the Conservation Agreements for Paradine Plains Cactus and Arizona Bugbane, provide for management and guidance for those rare endemic plants. In addition, Bill Williams Mountain (which encompasses the Arizona Bugbane Botanical Area) has been identified as a management area under all action alternatives.

The recommendation of Garland Prairie for formal designation as a research natural area under alternative A was never formalized. Since its original recommendation, this vegetation type has become well represented in the national network of field ecological research natural areas, and as a result there is a low need. This 340-acre area on the Williams Ranger District is typical of the high elevation grassland ecotone dominated by Arizona fescue and mountain muhly, has been excluded from grazing since about 1989. Under alternatives B, C, and D, this area would be maintained as a natural area, but as a management area in the plan and would no longer be recommended for formal designation.

The Endangered Species Act (1973) provides guidance for management and conservation of threatened or endangered species. Management actions adversely affecting these species require consultation and coordination with the U.S. Fish and Wildlife Service. There is one plant species protected under the Endangered Species Act on the Kaibab NF, Fickeisen Plains Cactus, which is a listed species. The action alternatives would have the same impacts to the federally listed and sensitive species except for those species that depend upon ponderosa pine and frequent fire mixed-conifer forest. The guideline for presettlement tree retention, the differing amounts of land managed for timber production, and lands recommended for wilderness are the substantive differences between alternative B and alternatives C and

D. The presettlement tree retention guideline under Alternatives C and D would affect all vegetation management activities associated with ponderosa pine, frequent fire mixed conifer, woodlands, and savannas. This guideline has the potential in areas that currently contain a high number of large trees to inadequately provide for the desired level of tree groups and openness within conifer stands. This guideline also could also affect restoring savanna and woodland habitat by retaining higher densities of conifer trees than would naturally occur in these areas, putting these systems at greater risk of density dependent uncharacteristic disturbance, such as active crown fire

Cumulative Environmental Consequences for Botanical Resources

The cumulative effects area considered in this analysis includes lands managed by National Park Service (Grand Canyon National Park), State of Arizona, Bureau of Land Management (BLM), the Coconino and Prescott NFs, the Navajo, Hualapai, Kaibab-Paiute, and Havasupai Tribes, and private landowners. These areas contain populations and/or habitat for these rare and endemic plant species. The time frame for this cumulative effects analysis is 50 years, 25 years in the past and 25 years into the future. This timeframe would encompass the lifespan of most of the plants in current populations, provide reference to actions that have affected the habitat such that the current populations exist as they do, and management actions implemented under the Preferred or other alternatives within 25 years in the future would show effects at the population level.

The Kaibab NF is located within three counties (Coconino, Mohave, and Yavapai) in Arizona, with the vast majority within Coconino County. Rare and endemic plants occur in the majority of these areas. Private lands within communities do not typically contain these plants because of drastic alteration of habitat. The Navajo, Hualapai, Kaibab-Paiute, and Havasupai Tribal lands have some populations of rare and endemic plants. State lands are typically used for winter grazing of the Forest permitted livestock. The BLM has both year-round grazing and winter grazing.

There would be no indirect consequences for two of the rare and endemic plant species (Groundcover milkvetch, Mat penstemon) addressed in this analysis (i.e., those Forest Plan Analysis plant species with low to moderate risks, and those that occur in areas outside of those being treated under the action alternatives) so there would be no cumulative effects for these species under those Alternatives.

The rare and endemic plant species programs for the Kaibab, Coconino, and Prescott National Forest have the same general requirements since they are guided by the same relevant laws, regulations, and policies that apply to the management of federal lands. The restrictions and limitations placed on the rare and endemic plant species will vary between the forests due to the various concerns or needs of the areas resource management. All three forests are currently in the process of Forest Plan Revision and have worked cooperatively on the information gathering, assessment and evaluation of the botanical resources, including the rare and endemic plant species and are revising their plans using the same concepts and processes. The Arizona Strip General Management Plan of 2007 (BLM portion of the plan; BLM 2008) has a very similar guiding laws regulations and policies as the Forest Service. The Grand Canyon National Park has a General Management Plan approved in 1995, that provides programmatic guidance for the whole Park (NPS 1995), and also a North Rim Development Plan (NPS 2006), and South Rim Visitor Transportation Plan (NPS 2008) that are broad-scale in nature. The adjacent lands managed by these agencies contain known or potential habitat for many of the Kaibab Forest Plan Analysis plant species. Within these cited documents are guidance for these land management areas regarding federally listed and candidate and rare and endemic plant species on lands immediately adjacent to the Kaibab NF. Overall these plans on adjacent lands, combined with the Desired Conditions, S&Gs of the Kaibab and adjacent Coconino and Prescott NFs, provide for maintenance and enhancement of the habitats of the rare and endemic plant species of northern Arizona within the jurisdictions of the land management agencies.

There are several weed management areas (WMAs) that include the Kaibab NF and/or adjacent lands. These are the San Francisco Peaks WMA that includes the Williams and Tusayan RDs, the Yavapai WMA adjacent to the SW corner of the Williams RD, and the Arizona Strip WMA, adjacent to and including the North Kaibab RD. The general aims of these WMAs are to facilitate communication among the members, coordinate, and implement weed treatments. Thus the invasive species that are currently, or likely to become, of concern on the Kaibab NF are recognized over the broader landscape surrounding the Kaibab NF. Actions taken in coordination throughout these weed management areas will enhance the effectiveness of efforts of Kaibab NF to control invasive plants on its own lands. The weed management areas have a positive effect on the effectiveness of weed prevention and treatments because, since invasive plants can spread rapidly over lands regardless of jurisdiction, the most effective way to prevent infestations is by prevention, early detection, and rapid effective treatment response to small new infestations wherever they occur.

Because this plan provides proactive protections for rare and endemic plant species through Desired Conditions, Objectives, Standards and Guidelines, the results of this plan, when added to the ongoing decisions and activities in the greater landscape, are local positive cumulative effects for these species.

The cumulative environmental consequences to rare and endemic plant species addressed in this analysis would have similar effects to present management or have beneficial effects for most of the plant species.

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